

**U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM**

SCIENTIFIC NAME: *Huperzia stemmermanniae*

COMMON NAME: Wawae`iole

LEAD REGION: Region 1

INFORMATION CURRENT AS OF: August 2005

STATUS/ACTION

☐ Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status

☐ New candidate

☒ Continuing candidate

☐ Non-petitioned

☒ Petitioned - Date petition received: May 11, 2004

☐ 90-day positive - FR date:

☒ 12-month warranted but precluded - FR date: May 11, 2005

☐ Did the petition request a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:

a. Is listing warranted (if yes, see summary of threats below)? yes

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? yes

c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded. We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions. During the past 12 months, most of our national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, meeting statutory deadlines for petition findings or listing determinations, emergency listing evaluations and determinations and essential litigation-related, administrative, and program management tasks. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the past 12 months, see the discussion of "Progress on Revising the Lists," in the current CNOR which can be viewed on our Internet website (<http://endangered.fws.gov>).

☐ Listing priority change

Former LP: ☐

New LP: ☐

Date when the species first became a Candidate (as currently defined): 1997

☐ Candidate removal: Former LP: ☐

☐ A – Taxon is more abundant or widespread than previously believed or not subject to

the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

- ___ U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.
- ___ F – Range is no longer a U.S. territory.
- ___ I – Insufficient information exists on biological vulnerability and threats to support listing.
- ___ M – Taxon mistakenly included in past notice of review.
- ___ N – Taxon does not meet the Act’s definition of “species.”
- ___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Ferns and allies, Lycopodiaceae (Clubmoss family)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, islands of Maui and Hawaii

CURRENT STATES/ COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, islands of Maui and Hawaii

LAND OWNERSHIP:

Two populations occur on State land within natural area reserves, and two populations occur on private land being considered for inclusion in Haleakala National Park, but have not yet been purchased.

LEAD REGION CONTACT: Paul Phifer, 503-872-2823, paul_phifer@fws.gov

LEAD FIELD OFFICE CONTACT: Pacific Islands Fish and Wildlife Office, Christa Russell, 808-792-9400, christa_russell@fws.gov

BIOLOGICAL INFORMATION:

Species Description *Huperzia stemmermanniae* is a pendant clubmoss epiphytic on barks of trees. Sterile stem bases are usually unforked or once-forked, short, usually much less than 15 centimeters (6 inches) long, green to pale yellow, with fertile terminal strobili. The strobili fork at an acute angle and the branches are usually straight (Palmer 2003).

Taxonomy *Phlegmariurus stemmermanniae* was first described by A.C. Medeiros, W.H. Wagner, and Hobdy, in 1986. Kartez moved the species to the genus *Huperzia*, which is the recognized genus in the latest treatment of ferns and fern allies in Hawaii (Palmer 2003), the most recent treatment of Hawaiian ferns.

Habitat This species is epiphytic on living trees or fallen logs in mesic *Metrosideros polymorpha* (‘ohi‘a)-*Acacia koa* (koa) forests on Maui and the island of Hawaii (Medeiros *et al.*

1996; Art Medeiros, U.S.G.S. Biological Resources Discipline, pers. comm. 1997; Palmer 2003).

Historical and Current Range/Current Status *Huperzia stemmermannii* was described in 1986 from collections on east Maui. Additional populations are found in Laupahoehoe on the island of Hawaii. Only four populations are known, totaling less than 20 individuals (Medeiros *et al.* 1996; Art Medeiros, U.S. Geological Survey-Biological Resources Discipline, pers. comm. 1997). We do not know of any recent surveys or long-term trends for this species, but it is reasonable to assume the populations have continued to decline, since not all of the threats are managed.

THREATS:

A. The present or threatened destruction, modification, or curtailment of its habitat or range.

Huperzia stemmermanniae is highly and imminently threatened by feral ungulates (pigs, goats, and cattle) (Medeiros *et al.* 1996; A. Medeiros, pers. comm. 1997). As early as 1778, European explorers introduced livestock, which became feral, increased in number and range, and caused significant changes to the natural environment of Hawaii. Past and present activities of introduced alien mammals are the primary factor altering and degrading vegetation and habitat on Maui and Hawaii. Pigs are currently present on Maui and Hawaii, and inhabit rain forests and grasslands. While rooting in the ground in search of the invertebrates and plant material they eat, feral pigs disturb and destroy vegetative cover, trample plants and seedlings, and threaten forest regeneration by damaging seeds and seedlings. They disturb soil and cause erosion, especially on slopes. Alien plant seeds are dispersed on their hooves and coats as well as through their digestive tracts, and the disturbed soil is fertilized by their feces, helping these plants to establish. Pigs are a major vector in the spread of many introduced plant species (Smith 1985; Stone 1985; Cuddihy and Stone 1990; Medeiros *et al.* 1986; Scott *et al.* 1986; Smith 1985; Stone 1985; Tomich 1986; Cuddihy and Stone 1990; Wagner *et al.* 1999a).

The goat (*Capra hircus*), a species originally native to the Middle East and India, was successfully introduced to the Hawaiian Islands in 1792. Currently, populations exist on Kauai, Oahu, Maui, and Hawaii. Goats browse on introduced grasses and native plants, especially in drier and more open ecosystems. Feral goats eat native vegetation, trample roots and seedlings, cause erosion, and promote the invasion of alien plants. They are able to forage in extremely rugged terrain and have a high reproductive capacity (Clarke and Cuddihy 1980; van Riper and van Riper 1982; Scott *et al.* 1986; Tomich 1986; Culliney 1988; Cuddihy and Stone 1990).

Cattle (*Bos taurus*), the wild progenitor of which was native to Europe, northern Africa, and southwestern Asia, were introduced to the Hawaiian Islands in 1793. Large feral herds developed as a result of restrictions on killing cattle decreed by King Kamehameha I. While small cattle ranches were developed on Kauai, Oahu, and west Maui, very large ranches of tens of thousands of acres were created on east Maui and Hawaii. Much of the land used in these private enterprises was leased from the State or was privately owned and classified as Forest Reserve and/or Conservation District. Feral cattle can presently be found on the island of Hawaii, and ranching is still a major commercial activity there. Cattle eat native vegetation, trample roots and seedlings, cause erosion, create disturbed areas into which alien plants invade,

and spread seeds of alien plants in their feces and on their bodies. The forest in areas grazed by cattle becomes degraded to grassland pasture, and plant cover is reduced for many years following removal of cattle from an area. Several alien grasses and legumes purposely introduced for cattle forage have become noxious weeds (Tomich 1986; Cuddihy and Stone 1990).

No known conservation measures have been implemented to date to address these threats.

B. Overutilization for commercial, recreational, scientific, or educational purposes.

None known.

C. Disease or predation.

Because Hawaii's native plants evolved without any browsing or grazing mammals present, many lost natural defenses to such impacts (Carlquist 1980, Lamoureux 1994). Browsing by ungulates has been observed on many other native species, including common and rare or endangered species (Cuddihy and Stone 1990; Loope *et al.* 1991). Therefore, even though there are no observations of browsing for this species, it is likely that pigs and goats impact this species directly as well as their indirect impacts to the surrounding habitat.

D. The inadequacy of existing regulatory mechanisms.

Hunting of feral cattle, one of the primary threats to this species, is no longer allowed in Hawaii (Hawaii Department of Land and Natural Resources 1985) except under permitted conditions. Cattle have been fenced out of the one population of this taxon; however, without continued monitoring and maintenance of those fences, cattle from surrounding pasture areas can easily access fenced areas. Pig and goat hunting is allowed year-round or during certain months, depending on the area (Hawaii Department of Land and Natural Resources n.d.-a, n.d.-b, n.d.-c). Hunting of feral cattle is no longer allowed in Hawaii (Hawaii Department of Land and Natural Resources 1985). However, public hunting does not adequately control the number of ungulates to eliminate this threat to native plant species. No other known conservation measures have been implemented to date to address this threat.

E. Other natural or manmade factors affecting its continued existence.

Numerous weed species threaten *Huperzia stemmermanniae* (discussed below) (Medeiros *et al.* 1996; A. Medeiros, pers. comm. 1997). The original native flora of Hawaii consisted of about 1,400 species, nearly 90 percent of which were endemic. Of the total native and naturalized Hawaiian flora of 1,817 taxa, 47 percent were introduced from other parts of the world, and nearly 100 species have become pests (Smith 1985; Wagner *et al.* 1999a). Confirmed personal observations (Medeiros *et al.* 1996; A. Medeiros, pers. comm. 1997) and several studies (Cuddihy and Stone 1990; Wood and Perlman 1997; Robichaux *et al.* 1998) indicate nonnative plant species may outcompete native plants similar to *H. stemmermanniae*. Competition may be for space, light, water, or nutrients, or there may be a chemical inhibition of other plants (Smith 1985; Cuddihy and Stone 1990). In addition, nonnative pest plants found in habitat similar to that of this species have been shown to make the habitat less suitable for native species (Smathers and Gardner 1978; Smith 1985; Loope and Medeiros 1992; Medeiros *et al.* 1992; Ellshoff *et al.* 1995; Meyer and Florence 1996; Medeiros *et al.* 1997; Loope *et al.* 2004). In

particular, alien pest plant species modify habitat by modifying availability of light, altering soil-water regimes, modifying nutrient cycling, or altering fire characteristics of native plant communities (Smith 1985; Cuddihy and Stone 1990; Vitousek *et al.* 1987). Because of demonstrated habitat modification and resource competition by nonnative plant species in habitat similar to the mesic *Metrosideros polymorpha*-*Acacia koa* forest habitat of *H. stemmermanniae*, the Service believes nonnative plant species are a threat to this species. No known conservation measures have been implemented to date to address this threat.

Introduced species that are a threat to *Huperzia stemmermanniae* include *Passiflora mollissima* (banana poka), *Psidium cattleianum* (strawberry guava), *Cyathea cooperi* (Australian tree fern), *Clidemia hirta* (Koster's curse), and *Miconia calvenscens* (miconia) (Medeiros *et al.* 1996). *Passiflora mollissima* (banana poka), a woody vine, poses a serious problem to mesic forests on Maui and Hawaii by covering trees, reducing the amount of light which reaches trees as well as understory, and causing damage and death to trees by the weight of the vines. Animals, especially feral pigs, eat the fruit and distribute the seeds (Cuddihy and Stone 1990; Escobar 1999). Two small tree species, *Psidium cattleianum* (strawberry guava) and *Psidium guajava* (common guava), were brought to Hawaii and have become widely naturalized on all the main islands, forming dense stands in disturbed areas. Strawberry guava, found in mesic and wet forests, develops into stands in which few other plants grow, physically displacing natural vegetation and greatly affecting Hawaiian plants, many of which are narrowly endemic taxa. Pigs depend on strawberry guava for food and, in turn, disperse the plant's seeds through the forests (Smith 1985; Wagner *et al.* 1999a). Strawberry guava is considered to be the greatest weed problem in Hawaiian rain forests (Smith 1985).

Recently introduced to Hawaii, *Cyathea cooperi* (Australian tree fern) is being promoted for commercial propagation in Hawaii to decrease exploitation of native tree ferns. Australian tree fern has recently become established on the island of Maui (Cuddihy and Stone 1990; A. Medeiros, pers. comm. 1994). Koster's curse, a noxious shrub native to tropical America, is found in mesic to wet forests on at least six islands in Hawaii (Hawaii Department of Agriculture 1981; Smith 1992; Almeda 1999). This noxious pest forms a dense understory, shading out other plants and hindering plant regeneration, and is considered the major alien plant threat (Cuddihy and Stone 1990). *Miconia calvenscens* (velvet tree) is a recently naturalized species native to tropical America. This species has become invasive in the Hilo and Pahoia areas of the island of Hawaii, and has become established on east Maui. This species has the potential to be very disruptive, as it has become an understory dominate where introduced to similar habitat in Tahiti (Cuddihy and Stone 1990; Almeda 1999).

Fire is also a threat to *Huperzia stemmermanniae* (Medeiros *et al.* 1996). Because Hawaiian plants were subjected to fire during their evolution only in areas of volcanic activity and from occasional lightning strikes, they are not adapted to recurring fire regimes and do not quickly recover following a fire. Alien plants are often better adapted to fire than native plant species, and some fire-adapted grasses have become widespread in Hawaii. Native shrubland and dry forest can thus be converted to land dominated by alien grasses. The presence of such species in Hawaiian ecosystems greatly increases the intensity, extent, and frequency of fire, especially during drier months or drought. Fire-adapted alien plant taxa can reestablish in a burned area,

resulting in a reduction in the amount of native vegetation after each fire. Fire can destroy dormant seeds as well as plants, even in steep or inaccessible areas. Fires may result from natural causes, or they may be accidentally or purposely started by humans (Cuddihy and Stone 1990, D'Antonio and Vitousek 1992; Friefelder *et al.* 1998).

In addition, species like *Huperzia stemmermannii* that are endemic to one or two small islands are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by genetic bottlenecks, random demographic fluctuations and localized catastrophes such as hurricanes. When considered on their own, the natural processes associated with being a narrow endemic and the habitat perturbation caused by hurricanes do not affect *Huperzia stemmermannii* to such a degree that it is threatened or endangered with extinction in the foreseeable future, but these natural processes can exacerbate the threat from anthropogenic factors, such as habitat loss for human development or predation by alien species.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

The National Park Service is considering acquisition of the land on Maui on which two of the four populations are found. The rate of acquisition and large-scale protection needed for this species may not, however, be initiated quickly enough to alleviate the threats to *Huperzia stemmermaniae* and implement management actions.

SUMMARY OF THREATS:

The major threats to this species include ungulates, nonnative plant species, and fire. In addition, the small number of remaining individuals make this species is susceptible to stochastic events. No conservation efforts have been initiated to date.

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2*
	Non-imminent	Subspecies/population	3
		Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:*Magnitude:*

This species is highly threatened by feral pigs, goats, and cattle that degrade and/or destroy habitat, fire, and nonnative plants that compete for light, space, and nutrients. Threats to the mesic forest habitat of *Huperzia stemmermanniae* and to individuals of this species occur throughout its range, and are expected to continue or increase without control or eradication. The low numbers of individuals and limited range also increase the risk of extinction risk to this species from the existing threats. No conservation efforts have been initiated to date.

Imminence:

Threats to *Huperzia stemmermanniae* from feral pigs, goats, cattle, fire, and nonnative plants are imminent because they are ongoing.

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted? No. The species does not appear to be appropriate for emergency listing at this time because the immediacy of the threats is not so great as to imperil a significant proportion of the taxon within the time frame of the routine listing process. Two populations occur on State land within natural area reserves, and the National Park Service is considering acquisition of the land on which the other two known populations are found, for inclusion in Haleakala National Park. If it becomes apparent that the routine listing process is not sufficient to prevent large losses that may result in this species' extinction, then the emergency rule process for this species will be initiated. We will continue to monitor the status of *G. kauaiense* as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

DESCRIPTION OF MONITORING:

Much of the information in this form is based on the results of two meetings of 20 botanical experts held by the Center for Plant Conservation in December 1995 and November 1996, and was updated by personal communication with Arthur C. Medeiros III of the U.S.G.S. Biological Resources Discipline in 1994 and 1996. We have incorporated additional information on this species from our files and the most recent supplement to the *Manual of the Flowering Plants of Hawaii* (Wagner and Herbst 2003). In 2004, the Pacific Islands office contacted the following species experts: Bob Hobdy, retired from Hawaii Division of Forestry and Wildlife; Joel Lau, the Hawaii Natural Heritage Program; Arthur C. Medeiros, U.S.G.S. Biological Resources Discipline; Hank Oppenheimer, resource manager for Maui Land and Pineapple Company; and Steve Perlman and Ken Wood, National Tropical Botanical Garden. No new status or range information was provided in 2004. In 2005 we contacted the species experts listed below, but received no new information on this taxon.

The Hawaii Natural Heritage Program identified this species as critically imperiled (Hawaii Natural Heritage Program Database 2004). Based on the International Union for Conservation of Nature and Natural Resources Red Plant Data Book rarity categories, this species is recognized as Endangered (at risk of extinction) by Wagner *et al.* (1999b).

Species experts were contacted but did not provide new information this year, no new literature was found, and no known entities are studying this species. However, it is highly likely that the previously reported threats continue to impact the species at the same or an increased level.

COORDINATION WITH STATES:

In October 2004 we provided the Hawaii Division of Forestry and Wildlife with copies of our most recent candidate assessments for their review and comment. Vickie Caraway, the State botanist, reviewed the information for this species and provided no additional information or corrections (V. Caraway, pers. comm. 2005).

LITERATURE CITED

List all experts contacted:

Name	Date	Place of Employment
1. Joel Lau	June 28, 2005	Hawaii Natural Heritage Program
2. Art Medeiros	June 28, 2005	U.S.G.S. Biological Resources Discipline
3. Jim Jacobi	June 28, 2005	U.S.G.S. Biological Resources Discipline
4. Rick Warshauer	June 28, 2005	U.S.G.S. Biological Resources Discipline
5. Hank Oppenheimer	June 28, 2005	Maui Land and Pineapple Company
6. Kapua Kawelo	June 28, 2005	U.S. Army
7. Dave Lorence	June 28, 2005	National Tropical Botanical Garden
8. Steve Perlman	March 29, 2005	National Tropical Botanical Garden
9. Ken Wood	August 2, 2005	National Tropical Botanical Garden
10. Marie Bruegmann	July 13, 2005	U.S. Fish and Wildlife Service
11. Vickie Caraway	June 14, 2005	Hawaii Division of Forestry and Wildlife

List all databases searched:

Name	Date
1. Hawaii Natural Heritage Program	2004

Other resources utilized:

- Almeda, F. 1999. Melastomataceae: in Wagner, W.L., D.R. Herbst, and S.H. Sohmer, Manual of the flowering plants of Hawai'i. University of Hawaii Press and Bishop Museum Press, Honolulu. Bishop Mus. Spec. Publ. 97: 903-917.
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- Francisco. 410 pp.
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- Hawaii, Department of Land and Natural Resources. N.d.-a. Summary of Title 13, Chapter 123, Game mammal hunting rules, island of Oahu. Division of Forestry and Wildlife, Honolulu. 2 pp.
- Hawaii, Department of Land and Natural Resources. N.d.-b. Summary of Title 13, Chapter 123, Game mammal hunting rules, island of Molokai. Division of Forestry and Wildlife, Honolulu. 2 pp.
- Hawaii, Department of Land and Natural Resources. N.d.-c. Summary of Title 13, Chapter 123, Game mammal hunting rules, island of Maui. Division of Forestry and Wildlife, Honolulu. 2 pp.
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- Lamoureux, C.H. 1994. Conserving Hawaiian biodiversity – the role of Hawaiian botanical gardens. Pp. 55-57. In: C.-I Peng and C.H. Chou (eds.). *Biodiversity and Terrestrial Ecosystems*. Institute of Botany, Academia Sinica Monograph Series No. 14.
- Loope, L.L., A.C. Medeiros, and B.H. Gagné. 1991. Recovery of Vegetation of a montane bog following protection from feral pig rooting. Coop. Natl. Park Resources Studies Unit, Univ. Hawaii/Manoa, Dept. Of Botany, Tech. Rept. 77.
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APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes to the candidate list, including listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all 12-month petition findings, additions of species to the candidate list, removal of candidate species, and listing priority changes.

Approve: **Acting** David W. Winkler 11/15/05
Regional Director, Fish and Wildlife Service Date

Marshall P. Jones

Concur: _____ August 23, 2006
Director, Fish and Wildlife Service Date

Do not concur: _____
Director, Fish and Wildlife Service Date

Date of annual review: September 16, 2005
Conducted by: Marie M. Brueggmann, Pacific Islands FWO
Plant Recovery Coordinator

Comments:
PIFWO Review

Reviewed by: Christa Russell Date: September 22, 2005
Plant Conservation Program Leader

Gina Shultz Date: October 14, 2005
Assistant Field Supervisor,
Endangered Species

Patrick Leonard Date: October 14, 2005
Field Supervisor